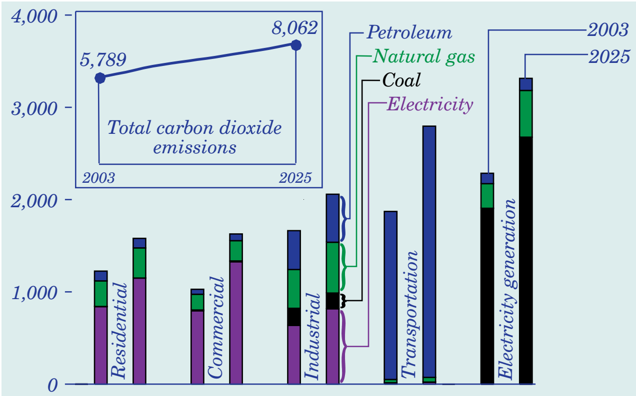
Higher Energy Consumption Forecast Increases Carbon Dioxide Emissions

Figure 110. Carbon dioxide emissions by sector and fuel, 2003 and 2025 (million metric tons)

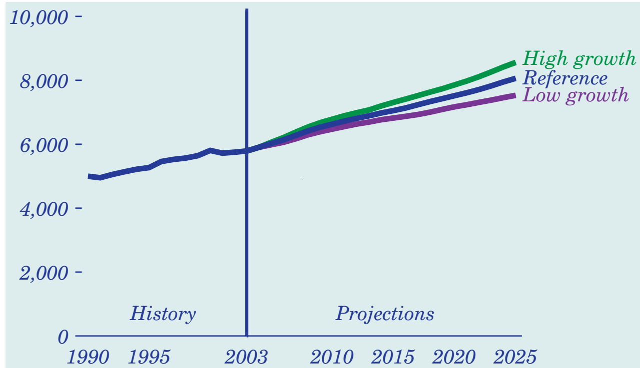


Carbon dioxide emissions from energy use are projected to increase on average by 1.5 percent per year from 2003 to 2025, to 8,062 million metric tons (Figure 110). Emissions per capita are projected to grow by 0.7 percent per year. New carbon dioxide mitigation programs, more rapid improvements in technology, or more rapid adoption of voluntary programs could result in lower emissions levels than projected here.

Carbon dioxide emissions in the residential sector, including emissions from the generation of electricity used in the sector, are projected to increase by an average of 1.2 percent per year, reflecting increased electrification and penetration of computers, electronics, and appliances in the sector. Significant growth in office equipment and computers, as well as floorspace, is also projected for the commercial sector, and carbon dioxide emissions from the sector are projected to increase by 2.1 percent per year from 2003 to 2025. Industrial emissions are projected to grow by 1.0 percent per year, as shifts to less energy-intensive industries and efficiency gains help to moderate the effect of growth in energy use. In the transportation sector, carbon dioxide emissions grow at an annual rate of 1.8 percent. Increases in highway, rail, and air travel are partially offset by efficiency improvements in rail freight and aircraft, but passenger vehicle fuel economy is projected to increase only slightly above 2003 levels. In the electric power sector, continued reliance on coal and growth in natural-gas-fired generation result in a projected average increase in carbon dioxide emissions of 1.7 percent per year and an increase in the sector's share of total emissions to 41 percent in 2025 from 39 percent in 2003.

Emissions Projections Change With Economic Growth Assumptions

Figure 111. Carbon dioxide emissions in three economic growth cases, 1990-2025 (million metric tons)



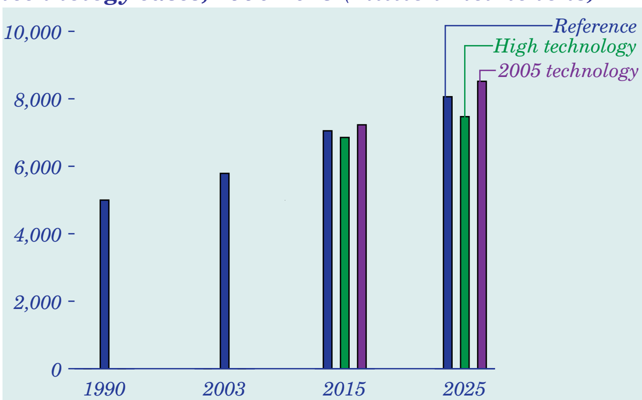
The high economic growth case assumes higher growth in population, labor force, and productivity than in the reference case, leading to higher industrial output, lower inflation, and lower interest rates. GDP growth in the high growth case averages 3.6 percent per year from 2003 to 2025, compared with 3.1 percent per year in the reference case. In the low economic growth case, GDP growth averages 2.5 percent per year.

Higher projections for manufacturing output and income increase the demand for energy services in the high economic growth case, and projected energy consumption in 2025 is 6 percent higher than in the reference case. As a result, carbon dioxide emissions are projected to be 6 percent higher than in the reference case in 2025, at 8,561 million metric tons (Figure 111). Total energy intensity, measured as primary energy consumption per dollar of GDP, declines by 1.9 percent per year from 2003 to 2025 in the high growth case, as compared with 1.6 percent per year in the reference case. With more rapid projected growth in energy consumption, there is expected to be a greater opportunity for turnover in the stock of energy-using technologies, adding new equipment and increasing the overall efficiency of the capital stock.

Projected total energy consumption in 2025 is 6 percent lower in the low economic growth case than in the reference case, and carbon dioxide emissions in 2025 are 7 percent lower, at 7,530 million metric tons. Energy intensity is projected to decline at an average rate of 1.4 percent per year from 2003 to 2025 in the low economic growth case.

Technology Advances Could Reduce Carbon Dioxide Emissions

Figure 112. Carbon dioxide emissions in three technology cases, 1990-2025 (million metric tons)

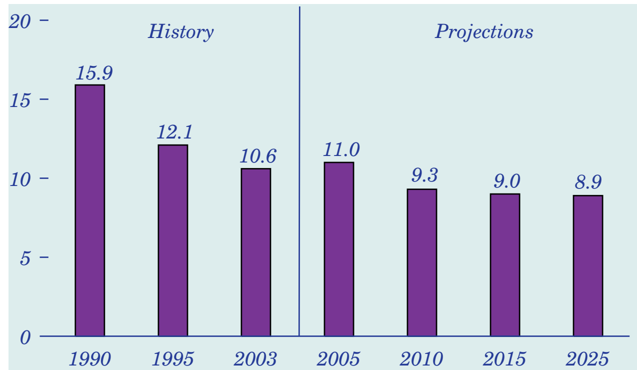


The reference case assumes continuing improvement in energy-consuming and producing technologies, consistent with historic trends, as a result of ongoing research and development. In the high technology case it is assumed that increased spending on research and development will result in earlier introduction, lower costs, and higher efficiencies for end-use technologies than assumed in the reference case. The costs and efficiencies of advanced fossil-fired and new renewable generating technologies are also assumed to improve from reference case values [*143*]. Energy intensity is expected to decline on average by 1.9 percent per year through 2025 in the high technology case, as compared with 1.6 percent in the reference case. As a result, energy consumption is projected to be 5 percent lower than in the reference case in 2025, at 126 quadrillion Btu, and carbon dioxide emissions are projected to be 7 percent lower than in the reference case, at 7,471 million metric tons (Figure 112).

The 2005 technology case assumes that future equipment choices will be made from the equipment and vehicles available in 2005; that new building shell and plant efficiencies will remain at their 2005 levels; and that advanced generating technologies will not improve over time. Energy efficiency improves in the 2005 technology case as new equipment is chosen to replace older stock and the capital stock expands, and energy intensity declines by 1.4 percent per year from 2003 to 2025. Energy consumption reaches 140 quadrillion Btu in 2025 in the 2005 technology case, and carbon dioxide emissions in 2025 are projected to be 6 percent higher than in the reference case, at 8,519 million metric tons.

Sulfur Dioxide Emissions Are Cut in Response to Tightening Regulations

Figure 113. Sulfur dioxide emissions from electricity generation, 1990-2025 (million short tons)



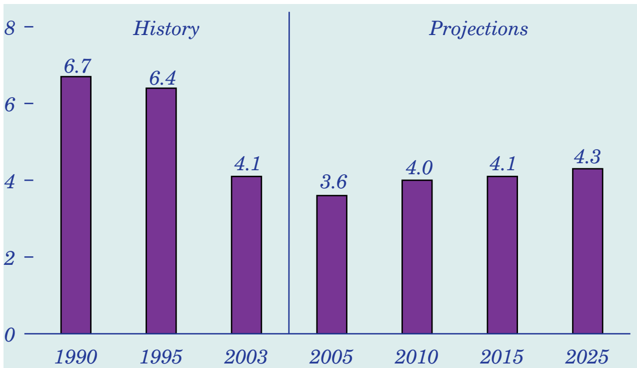
CAAA90 called for annual emissions of SO_2 by electricity generators in the power sector to be reduced to approximately 12 million short tons in 1996, 9.48 million short tons per year from 2000 to 2009, and 8.95 million short tons per year thereafter. Because companies can bank allowances for future use, however, the long-term cap of 8.95 million short tons per year is not expected to be reached until after 2012. Coal combustion accounts for more than 95 percent of the SO_2 produced by generators.

CAAA90 called for the reductions to occur in two phases, with larger (more than 100 megawatts) and higher emitting (more than 2.5 pounds per million Btu) plants making reductions first. In Phase 1, which began in 1995, 261 generating units at 110 plants were issued tradable emissions allowances that permitted their SO_2 emissions to reach a fixed amount per year—generally less than the plant's historical emissions. Allowances could also be banked for use in future years. Switching to lower sulfur subbituminous coal was the option chosen by most generators, and only about 12 gigawatts of capacity had been retrofitted with scrubbers by 1995.

Power companies have announced plans to add scrubbers to 22 gigawatts of capacity in order to comply with State or Federal initiatives. About 6 gigawatts of additional capacity is projected to be retrofitted with scrubbers. SO_2 emissions are projected to drop from 10.6 million short tons in 2003 to 8.9 million tons in 2025 (Figure 113). The SO_2 emission allowance price is projected to rise to near \$275 per ton in 2010 as banked allowances are used and to remain between \$250 and \$325 per ton from 2010 through 2025.

Nitrogen Oxide Emissions Are Projected To Fall in the Near Term

Figure 114. Nitrogen oxide emissions from electricity generation, 1990-2025 (million short tons)



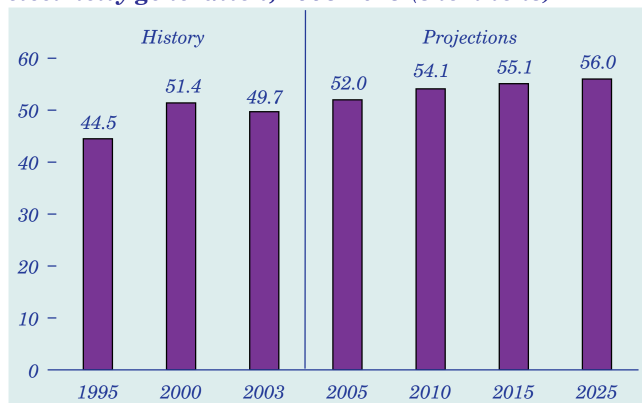
NO_x emissions from electricity generation in the U.S. power sector are projected to fall in the short term as new regulations take effect (Figure 114). The required reductions are intended to reduce the formation of ground-level ozone, for which NO_x emissions are a major precursor. Together with volatile organic compounds and hot weather, NO_x emissions contribute to unhealthy air quality in many areas during the summer months.

For several years, the EPA and the States have studied the movement of ozone from State to State. The States in the Northeast have argued that emissions from coal-fired power plants in the Midwest make it difficult for them to meet national air quality standards for ground-level ozone, and they have petitioned the EPA to force plant operators to reduce emissions by more than required under current rules.

The Ozone Transport Rule called for capping NO_x emissions in Midwestern and Eastern States, and limits have been finalized for 19 States. The limits, which apply to NO_x emissions during the 5-month summer season in the 19 States covered, are expected to stimulate additions of emission control equipment to some existing plants. National NO_x emissions are projected to increase from 4.1 million short tons in 2003 to 4.3 million short tons in 2025. Due to the geographical restriction of the cap, coal use and NO_x emissions are expected to increase at plants outside the 19 covered States. Overall, selective catalytic reduction equipment is projected to be added to approximately 74 gigawatts of capacity, and NO_x allowance prices are projected to range from roughly $4,000 to $5,600 per ton between 2005 and 2025.

Mercury Emissions Are Expected To Grow With Increased Coal Use

Figure 115. Mercury emissions from electricity generation, 1995-2025 (short tons)



Mercury is a metallic element that occurs naturally in all types of coal. Its concentration can vary significantly by coal type and origin, even within a single mine. There are no Federal regulations on mercury emissions from power plants, but the EPA is considering mandatory limits. Several States have adopted or are considering mercury control regulations for power plants within their jurisdictions.

Emissions of mercury depend on a variety of site-specific factors, including the amounts of mercury and other compounds (such as chlorine) in the coal, the boiler type and configuration, and the presence of pollution control equipment such as fabric filters, electrostatic precipitators, flue gas desulfurization, and selective catalytic control equipment. Technologies that remove SO_2 and NO_x have shown promise in removing mercury from bituminous coals but have not performed as well with lower ranked coals [*144*]. The U.S. Department of Energy, together with industry partners, is sponsoring research and development programs on advanced technologies to reduce mercury emissions from power plants.

The *AEO2005* reference case assumes no regulation of mercury emissions in the electricity generation sector through 2025, and the average mercury content of coal burned at power plants is assumed to stay relatively constant at about 7.4 pounds per trillion Btu of energy input to coal-fired electricity production. Consequently, with coal use for electricity generation projected to increase, total mercury emissions from power plants are also projected to increase, from 49.7 short tons in 2003 to 56.0 short tons in 2025 (Figure 115).